SCIENTIFIC NOTE

Imidachloprid as a Protectant for Endangered Plants Attacked by *Sophonia rufofascia*

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Abstract. An experiment was conducted to assess the efficacy of the systemic insecticide imidachloprid (Marathon® 1% granular) against the two-spotted leafhopper, *Sophonia rufofascia* (Kuoh and Kuoh). A high (3.3 ml) and low (1.6 ml) rate of imidachloprod was applied to the endangered Hawaiian plant *Munroidendron racemosum* (Forbes) Sherff in 30.5 cm pots. Early nymphal stages of *S. rufofascia* were placed on plants at 5, 12, 25, 37, and 50 d after application and counted 24 h later. At the high rate, leafhopper mortality was >80% for more than 5 wk. Imidachloprid is potentially a valuable tool for pest management of rare and endangered species in botanical gardens and in the wild.

The two-spotted leafhopper, *Sophonia rufofascia* (Kuoh and Kuoh), is a recent accidental introduction to the Hawaiian Islands. It has been recorded in Hawaii from 307 plant species in 83 families (Fukada 1996), of which 66 are endemic or indigenous and 16 are listed as threatened or endangered.

In some cases, botanical gardens and natural preserves are the only means to prevent extinction of endangered plants. For example, *Munroidendron racemosum* (Forbes) Sherff occurs in nature as a dozen populations with a total of 50-100 plants on the island of Kauai (USFandWS 1995), and is being propagated by the Honolulu Botanical Garden from tissue culture for reintroduction into wild areas. The two-spotted leafhopper attacks *M. racemosum* in botanical gardens and in the wild, and insecticides may be necessary to reduce plant stress and ensure survival. The objective of this study was to test the efficacy of the systemic insecticide imidachloprid against *S. rufofascia* on *M. racemosum.*

Materials and Methods

Munroidendron racemosum plants were propagated in 30.5 cm pots at Ho'omaluhia Botanical Garden in Kaneohe, Hawaii, then transferred on 1 June 1996 to Koko Head Botanical Garden before initiating the experiment. Potted plants were grown on benches outdoors in a naturally shaded area. Plants received 100 ml of water every other day for the duration of the experiment; no precipitation fell during the experiment. On 13 June 1996, *M. racemosum* plants, approximately 30-40 cm height, were treated with one application of imidachloprid (Marathon 1% granular) in a replicated randomized design with 6 plants per treatment. Treatments consisted of high (3.3 ml per 30.5 cm pot) and low (1.6 ml per 30.5 cm pot) rates of imidachloprid. An additional 6 plants were left untreated as controls. Ten early-stage nymphs were placed on a single leaf enclosed in organdy screen cages for each plant. Nymphs were placed on plants 5, 12, 25, 37, and 50 d after insecticide application. Counts were made of live and dead leafhopper nymphs and cast skins on intact leaves 24 h after placement, and then individuals were removed. Percent mortality data for each place-

ment date were arcsin transformed and subjected to ANOVA (SAS Institute 1994); mean separations were performed using the Student's *t*-test.

Results and Discussion

Imidachloprid was effective in reducing numbers of early stage nymphs of *S. rufofascia*. Dead leafhoppers were typically found at the bottom of the screen cage, off the leaf, while survivors were on the leaf, and in some cases, had molted to the next stage and left a cast skin. On plants receiving the high rate of imidachloprid, mortality of *S. rufofascia* was 100% (n = 6) on day 5 and declined to 51.0 $\pm$ 5.0% (mean $\pm$ SEM) (n = 6) on day 50 (Fig. 1). Mean leafhopper mortality at the high rate of imidachloprid was >80% for 5 wk. At the low rate of imidachloprid, mortality was 95.0 $\pm$ 3.0% (n = 6) on day 5 and declined steadily to 36 $\pm$ 5.0% (n = 6) on day 50. On all days, *S. rufofascia* mortality on treated plants was significantly higher than that on untreated control plants (Fig. 1). Mortality on plants receiving the high rate of insecticide was significantly higher than mortality on low dose plants only on day 37 (t = 2.2; df = 10; P = 0.01), but the trend was always for higher mortality on plants receiving a high dose compared with low dose plants. Mean control mortality on the five placement dates was 7.5 $\pm$ 2.0%.

Insect pests, like *S. rufofascia*, can stress rare plants in fragile environments. The precarious existence of *M. racemosum* in nature is not unique. Other endangered plants besides *M. racemosum* that are *S. rufofascia* hosts are also on the brink. An extreme case is the endangered plant *Hibiscadelphus giffardianus* Rock which exists in the wild as only 11 remaining individuals in Kipuka Puaulu in Hawaii Volcanoes National Park. Chlorotic leaves on these plants have been attributed to feeding by *S. rufofascia* (David Foote, personal communication). Imidachloprid could be used to protect *H. giffardianus* in the wild and in nurseries where it is being propagated for outplanting to supplement wild populations.

The granular formulation of imidachloprid (Marathon) appears to be an ideal plant protectant: it is effective for a long period of time, easily applied to the soil, and systemic which greatly reduces the chance of environmental contamination and toxicity to natural enemies and pollinators. In addition to leafhoppers, imidachloprid shows activity against many other homopteran (aphids, psyllids, whiteflies) and hemipteran pests, as well as thrips and several coleopterans (Mullins 1993). Therefore, it may have a broad range of applications for pest management of rare and endangered plants in Hawaii.

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Figure 1. Mortality of *S. rufofascia* nymphs 24 h after placement on *M. racemosum* leaves at various intervals after treatment with imidachloprid.